Claims:

1. A copper electrochemical plating system, comprising:

a plating cell having an electrolyte inlet and an electrolyte drain;

an electrolyte storage unit in fluid communication with the electrolyte inlet; and

an electrodialysis chamber in fluid communication with the plating cell, the electrodialysis chamber being configured to receive a portion of electrolyte solution and remove contaminants therefrom.

2. The copper electrochemical plating system of claim 1, wherein the electrodialysis chamber comprises:

a housing having a cathode electrode positioned in a first end and an anode electrode positioned in a second end, the second end being oppositely positioned from the first end;

at least one depletion chamber positioned between the cathode electrode and the anode electrode; and

at least one high concentration chamber positioned between the cathode electrode and the anode electrode.

3. The copper electrochemical plating system of claim 2, wherein the at least one depletion chamber comprises:

a fluid inlet configured to receive used electrolyte;

an anodic membrane defining a first side of the depletion chamber;

a cathodic membrane defining a second side of the depletion chamber, the second side being positioned opposite the first side; and

a depletion chamber fluid outlet configured to dispense waste electrolyte and contaminants therefrom.

4. The copper electrochemical plating system of claim 3, wherein the first side is positioned closer to the anode electrode than the cathode electrode and where the second side is positioned closer to the cathode electrode than the anode electrode.

5. The copper electrochemical plating system of claim 2, wherein the at least one high concentration chamber comprises:

an anodic membrane positioned on a cathode side of the high concentration chamber;

a cathodic membrane positioned on the anode side of the high concentration chamber; and

a concentration chamber fluid outlet configured to dispense restored electrolyte therefrom.

6. The copper electrochemical plating system of claim 2, wherein the cathode side of the high concentration chamber is positioned closer to the cathode electrode than the anode electrode and wherein the anode side of the high concentration chamber is positioned closer to the anode electrode than the cathode electrode.

7. The copper electrochemical plating system of claim 2, wherein the at least one high concentration chamber is separated from the at least one depletion chamber by at least one of a cationic membrane and an anionic membrane.

8. The copper electrochemical plating system of claim 7, wherein the anionic membrane comprises a membrane having selectivity towards positively charged ions.

9. The copper electrochemical plating system of claim 7, wherein the anionic membrane is configured to allow negatively charged ions to pass therethrough in the direction of the anode.

10. The copper electrochemical plating system of claim 7, wherein the anionic membrane is configured to prevent positively charged ions from passing therethrough in the direction of the anode.

11. The copper electrochemical plating system of claim 7, wherein the cationic membrane is configured to allow positively charged ions to pass therethrough in the direction of the cathode.

12. The copper electrochemical plating system of claim 7, wherein the cationic membrane is configured to prevent negatively charged ions from passing therethrough in the direction of the cathode.

13. The copper electrochemical plating system of claim 2, further comprising:

an anode chamber positioned adjacent the anode electrode; and

a cathode chamber positioned adjacent the cathode electrode.

14. The copper electrochemical plating system of claim 13, wherein the anode chamber and the cathode chamber are configured to isolate the anode electrode and the cathode electrode from at least one depletion chamber and the at least one high concentration chamber.

15. The copper electrochemical plating system of claim 13, wherein the anode chamber is in fluid communication with the cathode chamber.

16. The copper electrochemical plating system of claim 2, further comprising at least one low concentration chamber positioned between the at least one high concentration chamber and the at least one depletion chamber.

17. The copper electrochemical plating system of claim 16, wherein the at least one low concentration chamber is configured to receive electrolyte from the at least one depletion chamber and output a diluted acid solution therefrom.

18. A copper plating system, comprising:

a plating cell having a cathode substrate support member and an electrolyte solution bath having an anode disposed therein;

an electrolyte storage tank configured to supply electrolyte to the electrolyte solution bath and receive used electrolyte from the plating cell via an electrolyte drain; and

an electrodialysis cell in fluid communication with the electrolyte drain, the electrodialysis cell comprising:

a plurality of depletion chambers and a plurality of concentration chambers; and

a cathode electrode and an anode electrode opposingly positioned to interstitially maintain the plurality of depletion chambers and the plurality of concentration chambers.

19. The copper plating system of claim 18, wherein the plurality of depletion chambers comprise:

an anionic membrane positioned on an anode side;

a cationic membrane positioned on a cathode side; and

a fluid inlet configured to receive used electrolyte in a region between the anionic membrane and the cathodic membrane.

20. The copper plating system of claim 18, wherein the plurality of concentration chambers comprise:

an anionic membrane positioned on a cathode side;

a cationic membrane positioned on an anode side; and

a fluid outlet configured to communicate concentrated acid solutions out of the concentration chamber.

21. The copper plating system of claim 18, wherein the electrodialysis cell further comprises:

a cathode chamber positioned proximate the cathode electrode and being separated from the plurality of depletion chambers and the plurality of concentration chambers by a cationic membrane; and

an anode chamber positioned proximate the anode electrode and being separated from the plurality of depletion chambers and the plurality of concentration chambers by a anionic membrane.

22. The copper plating system of claim 21, wherein the cathode chamber and the anode chamber are in fluid communication and have an acid solution circulated between the respective chambers.

23. The copper plating system of claim 18, wherein the electrodialysis cell further comprises at least one low concentration chamber positioned between one of the plurality of concentration chambers and one of the plurality of depletion chambers.

24. The copper plating system of claim 23, wherein the at least one low concentration chamber comprises:

a first anionic membrane positioned on an anode side of the low concentration chamber;

a second anionic membrane positioned on an anode side of the low concentration chamber;

a fluid inlet configured to receive a diluted acid solution from an output of one of the plurality of concentration chambers; and

a fluid outlet configured to dispense a diluted acid solution therefrom.

25. The copper plating system of claim 18, wherein the plurality of concentration chambers and the plurality of depletion chambers are defined by anionic membranes and cationic membranes.

26. The copper plating system of claim 25, wherein the anionic membranes are configured to allow negatively charged ions to pass therethrough in the direction of the anode, and wherein the cationic membranes are configured to allow positively charged ions to pass therethrough in the direction of the cathode.

27. The copper plating system of claim 25, wherein the anionic membranes are configured to prevent positive ions from passing therethrough in the direction of the anode, and wherein the cationic membranes are configured to prevent negative ions from passing therethrough in the direction of the cathode.

28. A method for plating copper, comprising:

supplying an electrolyte solution to a copper plating cell;

plating copper onto a substrate in the plating cell with the electrolyte solution;

removing used electrolyte solution from the plating cell; and

refreshing a portion of the used electrolyte solution with an electrodialysis cell.

29. The method of claim 28, wherein refreshing a portion of the used electrolyte with an electrodialysis cell comprises:

receiving the used electrolyte solution in a first end of a depletion chamber;

urging positive copper ions and positive hydrogen ions to diffuse through a cationic membrane towards a cathode into a concentration chamber;

urging negative sulfate ions to diffuse through an anionic membrane towards an anode into the concentration chamber; and

removing a copper sulfate solution from the concentration chamber.

30. The method of claim 29, further comprising combining the positive copper ions and the negative sulfate ions together in the concentration chamber to form the copper sulfate solution.

31. The method of claim 29, wherein the urging steps comprise applying an electrical bias across the electrodialysis cell.

32. The method of claim 31, wherein a voltage of the electrical bias is approximately equal to a number of electrodialysis cells.

33. The method of claim 29, further comprising circulating a sulfuric acid solution between a cathode chamber positioned proximate a cathode electrode and an anode chamber positioned proximate an anode electrode.

34. The method of claim 29, further comprising removing a dilute acid solution having electrolyte contaminants therein from a second end of the depletion chamber.

35. A method for replenishing a copper plating solution, comprising:

receiving a portion of a used copper plating solution in a first end of a depletion chamber of an electrodialysis chamber;

urging positively charges copper ions into a concentration chamber;

urging negatively charged sulfate ions into the concentration chamber;

generating concentrated copper sulfate in the concentration chamber; and

returning the concentrated copper sulfate to the copper plating solution.

36. The method of claim 35, further comprising applying an electrical bias across the depletion chamber.

37. The method of claim 36, wherein a voltage of the electrical bias is approximately equal to a total number of concentration chambers and depletion chambers.

36. The method of claim 35, wherein the receiving step comprises receiving the used electrolyte solution in up to 500 depletion chambers within a single electrodialysis cell.

36. The method of claim 35, wherein the concentration chamber is positioned adjacent the depletion chamber.

37. The method of claim 36, wherein the concentration chamber is separated from the depletion chamber on a first side by an anodic membrane and on a second side by a cathodic membrane, wherein the first side is proximate a cathode electrode and the second side is proximate an anode electrode.

38. The method of claim 35, further comprising circulating an acid solution between an anode chamber positioned immediate an anode electrode and a cathode chamber positioned immediate a cathode electrode.

39. The method of claim 35, further comprising removing a diluted acid solution and electrolyte contaminants from a second end of the depletion chamber.

40. The method of claim 39, wherein the diluted acid solution and electrolyte contaminants comprise about 5 to about 10 percent of a volume of used copper plating solution received in the first end of the depletion chamber.

41. The method of claim 35, wherein the returned concentrated copper sulfate solution comprises about 85 to about 95 percent of a total volume of used electrolyte solution supplied to the depletion chamber.

42. The method of claim 35, further comprising positioning a plurality the concentration chambers adjacent a plurality of the depletion chambers in an alternating manner, wherein the plurality of concentration chambers and the plurality

of depletion chambers are separated by at least one of an anionic membrane and a cationic membrane.

43. The method of claim 42, wherein a total of the plurality of concentration chambers and the plurality of depletion chambers is between about 5 and about 500.

44. The method of claim 42, wherein a total of the plurality of concentration chambers and the plurality of depletion chambers is between about 25 and about 100.

45. A copper electrochemical plating system, comprising:

a plating cell having a substrate support member in electrical communication with a cathode source and an electrolyte solution bath having a anode source in electrical communication therewith;

an electrolyte storage tank configured to supply electrolyte to the electrolyte solution bath and receive used electrolyte from the plating cell via an electrolyte drain, the electrolyte solution bath having copper sulfate therein as a source of copper ions to be plated; and

an electrodialysis cell in fluid communication with the plating cell, the electrodialysis cell comprising:

a chamber having a cathode electrode positioned at a first end and an anode electrode positioned at a second end, the first end being oppositely positioned from the second end;

at least one depletion chamber positioned between the cathode electrode and the anode electrode; and

at least one concentration chamber positioned between the cathode electrode and the anode electrode.

46. The copper electrochemical plating system of claim 45, wherein the at least one depletion chamber adjoins the at least one concentration chamber.

47. The copper electrochemical plating system of claim 45, wherein the at least one depletion chamber and the at least one concentration chamber are separated by at least one of a cationic membrane and an anionic membrane.

48. The copper electrochemical plating system of claim 45, wherein the at least one depletion chamber and the at least one concentration chamber are positioned in an alternating order.

49. The copper electrochemical plating system of claim 45, further comprising an isolation chamber positioned proximate the anode electrode and the cathode electrode.